

# A Review of the Available Literature on the Use of Organo-Mineral Fertilizers (OMF) for Food Production in the World and Turkiye

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**Abstract**—Reducing the environmental impact and increasing the nutrient use efficiency of organic fertilizers require technological developments for the adequate use of organic residues in agriculture all over the world. Organic matter content differs in the vast majority of soils. However, with the widespread use of chemical fertilizers, the resources that were used in the past and that contributed to the organic matter content of the soil became unusable and even these resources began to be considered as waste. Soil organic matter is one of the key indicators not only for agricultural productivity but also for environmental resilience. Intensive monoculture agriculture, erosion, tillage, chemical fertilizers and pesticides reduce soil organic matter. The basis of sustainable agricultural practices is based on practices that protect and improve the amount of organic matter and soil organisms. One of these applications is the use of organo-mineral fertilizers (OMF) in fertilization. Studies have shown that the effects of organomineral fertilizers on yield are variable. Accordingly, in some studies, it resulted higher yields than mineral fertilizers and in the other studies lower yields were observed. On the other hand, it also noted that the yield values obtained from organomineral and mineral fertilizer applications are mostly close to each other. Although there is some limited information on the use of organomineral fertilizers in cereal crops, most research has been done on vegetables, fruits and specialty crops. Overall, research has shown that organomineral fertilizers can improve plant growth parameters such as yield and nutrient uptake to a greater degree than the use of fertilizers or fertilizers alone. This review presents a review of the available literature on the use of organo mineral fertilizers for food production.

**Index Terms**—Organo mineral fertilizers, soil fertility, plants parameters, organic fertilizers, environmental, organic matter, mineral fertilizer.

## 1 INTRODUCTION

Organomineral fertilizer; It can be defined as liquid and solid fertilizer formed as a result of the reaction or mixing of one or more organic fertilizers with one or more single, composite, secondary or micronutrient mineral fertilizers. Organomineral fertilizers reduce the loss of nutrients by washing and at the same time increase the efficiency of mineral fertilizers used by improving the fertility parameters of the soil [1].

Organic and organomineral fertilizers are seen as the best alternative in increasing the organic matter content of the soil and reducing the use of chemical fertilizers. The demand for organic and organomineral fertilizers is increasing day by day in the world and in our country.

The common idea in studies on the subject is that organomineral fertilizers are the best alternative to chemical fertilizers in terms of improving plant nutrient supply capacity and soil properties.

This review has been prepared as a result of examining some studies on organomineral fertilizers in the world and in Turkiye. In studies on organomineral fertilizers in different countries (Germany, England, Turkiye, Nigeria, Italy, Spain, etc.), their effects on yield parameters in different plants and their effects on the physical, chemical and biological properties of the soil were investigated. With this; It also covers the comparison of organomineral and chemical fertilizers and the studies for the production of organomineral fertilizers from various materials.

## 2 SUMMARY OF SOME CURRENT LITERATURE

Silva et al in a research study conducted "Growth and Nutrition of Peanut Crop Subjected to Saline Stress and Organomineral Fertilization " was evaluated the growth and leaf

nutrient contents of peanut plants subjected to watering with salt water and different organomineral fertilization. The trial was established in five iterations to a factorial trial pattern based on full chance under greenhouse conditions. Five types of fertilization (F1=100% mineral; F2=100% bovine biofertilizer; F3=100% vegetable ash; F4=50% mineral+50% bovine biofertilizer and F5=50% mineral+50% vegetable ash) and irrigation water (ECw) two electrical conductivity levels (1.0 and 5.0  $\text{dS m}^{-1}$ ) were tested. Salt stress reduced plant growth and the number of leaves, but the use of 100% bovine biofertilizer and higher brine increased the average trunk diameter. When bovine biofertilizer (100%) and 5.0  $\text{dS m}^{-1}$  ECw were used together, the concentration of P in plants increased. Mg concentration decreased in plants fertilized with 5.0  $\text{dS m}^{-1}$  irrigation water with cattle biofertilizer (100%) or mineral fertilizer (50%)+cattle biofertilizer (50%), while K concentration decreased in plants fertilized with bovine biofertilizer (100%) and vegetable ash (100%) [2].

Silva et al in a research study conducted "Mineral, Organic and Organomineral Fertilization Associated with Base Saturation in Cowpea (*Vigna Unguiculata* L.) Cultivation" studies; 30% or 60% base saturated mineral, organic (wood ash) and organomineral (organic+mineral) evaluated the effects of fertilizers on the growth and development of cowpea. The use of wood ash alone and in combination with mineral fertilizer reduced soil acidity and increased shoot growth, the number of tubers and the efficiency of water use. Wood ash can be used as fertilizer for agricultural sustainability and reduction of production costs, especially among small farmers who grow cowpea (*Vigna Unguiculata* L.) [3].

Silva et al in a research study conducted "Growth and Produc-

tivity of Agata Potato Cultivar under Different doses of Organomineral Fertilizer " was evaluated the effectiveness of organomineral fertilizers in the cultivation of Agata variety under Cerrado conditions. According to the trial split parcels trial pattern, organomineral fertilizer (2800 kg ha<sup>-1</sup>, formulated 3-32-6) corresponding to 40%, 60, 80, 100 and 120% of the mineral fertilizer dose in the four recurring main parcels and the sub-parcels were time (61, 74, 89 and 110 days after planting) and four repetitions. The recommended dose for potato cultivation has been reported to provide higher tuber yield as well as higher dry mass accumulation with commercial value with organomineral fertilizer at 40%, and the use of organomineral fertilizers shows the same performance as mineral fertilizers [4].

Ferreira et al in a research study conducted "Organomineral Fertilizer as an Alternative to Improving Potato Yield and Quality" was determined the appropriate ratio of organomineral fertilizer instead of mineral fertilizer to improve potato yield and quality. Attempts are four repetitions according to the trial pattern of blocks based on full chance; It consisted of six processes including four doses of organomineral fertilizer application (25, 50, 75 and 100% of mineral fertilizer demand), one mineral fertilizer application (100% mineral fertilizer application) and control (without fertilizer). Potato yield and quality, plant and soil nutrient contents were monitored. pH and total soluble nutrient contents were positively correlated with yield. Higher K>N>P content accumulated on the leaves, stems and tubers of potatoes. To improve potato yield and quality, the application rate of 3.7 t ha<sup>-1</sup> organomineral fertilizer (equivalent to 100% of mineral fertilizer); organomineral fertilizer has been reported to be a viable alternative to increase plant and soil nutrient content [5].

Felippe Ratke et al in a research study conducted was to determined "The Effects of Organomineral and Humic Mineral Fertilizers on Soil Organic Matter Fractions and Enzyme Activities". Fertilization practices was not affected enzyme activities but showed positive correlation with particulate organic carbon. As a result of the study, it was reported that the use of organomineral fertilizers may promote the increase of organic matter and affect the enzymatic activity of the soil [6].

Oliveira et al in a research study conducted was to determined "Soil Organomineral Fertilization in Garlic". They was reported that the use of 80% organomineral fertilizers showed the same performance in efficiency compared to 100% minerals and offered a lower percentage of discarded garlic onions, providing higher quality in garlic as well as adding value to the national garlic chain [7].

Silva et al in a research study conducted was to determined "Biochemical Changes and Development of Soybeans with the Use of Pelletized Organomineral Fertilizers Containing Sewage Sludge and Filter Cake". The study consisted of two organic matter sources (sanitized sewage sludge and filter cake) and four nitrogen levels (50, 75, 100 and 125%) according to the recommended dose of phosphorus pentoxide compared to mineral fertilizer in the trial pattern of 2x4+2 factorial coincidence blocks. With a 75% sewage sludge formulation, the use of organomineral fertilizers has grown further. In the use of biofertilizers, quantitative changes in peroxidase, catalase and

urease activity have been observed, as well as lipid peroxidation. They report that biofertilizers formulated with sewage sludge and filter cake can replace mineral fertilizer and boost soybean growth, and there is a need for studies examining the use of this particular class of fertilizer [8]

Silva et al in a research study conducted was to determined "Use of Organomineral Phosphate Fertilizer Instead of Mineral Phosphate in Corn Cultivation". In two locations belonging to the Municipality of Uberlândia-MG-Brazil, the effects of primary pelletized organomineral fertilizer application to the corn plant in two soils of different textures were examined on the macro and micronutrient content in the leaf, yield parameters and yield compared to mineral fertilization. The results highlighted that there was no difference between yield and the number of plants in line, excluding leaf phosphorus content, in clay and sandy soils, so organomineral phosphate is as effective as mineral for phosphorus supply [9].

Silva et al in a research study conducted was to determined application of "Organomineral and Mineral Nitrogen Fertilizer on Different Textured Soils in Corn Plants". In their trial in two different soil textures (sandy, clay) in two different locations in the municipality of Uberlândia-MG-Brazil, they aimed to compare the effects of mineral and organomineral nitrogen fertilizers in corn cultivation. There was no statistically significant difference between sandy and clay soils, as well as the content of dry mass and stem diameter in the leaf, excluding nitrogen and potassium, as well as doses. Thus, it is stated that organomineral fertilizer was as effective as mineral fertilizer in corn. They reported that the use of organomineral fertilizers can increase productivity, and that the application of organomineral fertilizers reduces fertilization costs and improves soil quality [10].

Crusciol et al in a research study conducted, was conducted to evaluate the agronomic and economic sugarcane (*Saccharum spp*) performances and residue "Effect of P and K under Mineral and Organomineral Fertilization" in their study. They reported that organomineral fertilizer is suitable for meeting sugarcane requirements and can completely replace mineral fertilizer. However, the effect on sugar yield is lower than the sap yield. As a result, organomineral fertilizer was more economically efficient and has achieved an average 12% increase in plant reed [11].

Smith et al focused on organomineral fertilizers produced by animal manure, "Organomineral fertilizers and application to field crops» study summarized with the current literature study on the use of organomineral fertilizers for food production. In the study, the production process and chemical composition of organomineral fertilizers also evaluated the effectiveness of organomineral fertilizer as a plant food source and reported that plant response to fertilizer could be encouraged and yielded positive results in a wide variety of products, including grain [12].

Mumbach et al in a research study conducted was to determined "Agricultural Productivity of Organomineral Fertilizer in Crop Watch Crops in Southern Brazil". Beans (*Phaseolus vulgaris*), corn (*Zea mays L.*) and wheat (*Triticum aestivum L.*) were grown in turn for two years in the trial. Before and after the trial, analysis was performed on soils taken from dis-

tances of 0-10 and 10-20 cm. As a result of the study, the use of fertilizer increased crop yields, but there was no difference between the three fertilizer sources or between 100% and 150% of the recommended one. Regardless of the source of fertilizer used, the chemical properties of the soil have changed in a similar way. As a result, organomineral fertilizer showed equivalent performance with mineral [13].

Silva et al in a research study conducted was to determine "The Effects of Organomineral Fertilizers Formulated with Biosolids and Filter Cake on Bean Yield (*Phaseolus vulgaris* L)". The effectiveness of organomineral fertilizers of different residue sources in its composition on bean yield was evaluated. The trial was carried out in a greenhouse at the Federal University of Uberlandia. Biosolid fertilizer-based organomineral fertilizer achieved the greatest growth with 100% of the recommended dose, the largest dry mass volume with up to 75% and the highest yield with 50%. The evaluated organomineral fertilizers showed the same performance as mineral fertilization in bean cultivation [14].

Grohskopf et al in a research study conducted was to research the interaction between phosphorus and nitrogen (P×N) in the nutrition of organomineral fertilizer «Phosphorus and Nitrogen in Organomineral Fertilizer». The application of organomineral fertilizers to the soil begins in the plant from a dose of 20 P×100 N on the dry biomass of the above-ground part of 50P×150N kg ha<sup>-1</sup> millet, an increase (synergy) has begun in both nutrients from 40P×100N and 40P×50N kg ha<sup>-1</sup> dose to 80P×200N kg ha<sup>-1</sup> dose. There was a synergistic interaction between P×N [15].

Ayinla et al in a research study conducted was to determine "The Effects of Organic, Inorganic and Organomineral Fertilizers on Growth, Yield and Nutrient Composition in *Corchorus Olitorius* (L)". In the study they reported that insufficient soil fertility is the most important factor limiting the cultivation of *Corchorus Olitorius* (L) as an important leafy vegetable rich in various sources of nutrients and dietary fiber in Africa, Asia and parts of the Americas in the tropics. The growth of *Corchorus Olitorius* (L) plants significantly improved yield and nutrient composition in all of the fertilizer-treated parcels compared to control. In the parcels where combined applications were carried out, higher growth parameters, yield and nutrient composition were significantly noted (p<0.05). This study reported that combined applications of organic and inorganic fertilizer can be used in soil remediation and increase the growth, yield and nutrient composition of *C. olitorius* [16].

Oliveira et al in a research study conducted "The Use of Organomineral Fertilizers Pelleted with Organic Matter Sources in their Composition in Sorghum Plants". As a result, organomineral fertilizers performed better at the end of 30 days than the control without fertilizers. After 60 days, sorghum fertilized with organomineral fertilizers gave positive results. Given the variables reported as a result of the study, they reported that organomineral fertilizers in sorghum development could replace mineral fertilizers even if the dose was reduced [17].

Lucelia et al in a research study conducted was to determine "The Effect of Organomineral Fertilizer and Poultry Litter on

some Plant and Soil Chemical Properties in Sugarcane Yield is to Apply Organic Wastes to Sugarcane (*Saccharum officinarum*) and Whether they can be Alternatives". The productivity of sugar cane was found to be higher in poultry litter and organomineral. It has been reported that organomineral fertilization is better than poultry litter and that soil phosphorus levels increase by fertilizing with poultry litter and organomineral. Soil K, Ca, Mg contents, acidity and amount of soil organic matter, and macronutrients in sugar cane were not differentiated with poultry litter and organomineral application compared with mineral fertilizer [18].

Cardoso et al in a research study conducted was to determine "Performance of Organomineral Fertilizers in Potato Product in Winter and Rainy Conditions» was compared organomineral fertilizer ratios and mineral fertilizer sources in different seasons in different seasons in Brazil and to evaluate productivity. In total, commercial and special class tubers in the winter crop, there was no significant difference of organomineral fertilizer compared to mineral. In the harvest of rainy crops, the average total yield of potato tubers was found to be 22% higher than mineral fertilizer in all organomineral fertilizer ratios. It has been reported that organomineral fertilizer provides agronomic efficiency for the cultivation of potatoes and can replace NPK mineral resources. The highest total yield was obtained at the rate of 4887.0 kg ha<sup>-1</sup> organomineral [19].

Martins in a research study conducted was to determine organomineral phosphorus fertilization in the Vigil of Corn, Soybean and Bean Planting, was evaluated the effect of phosphate fertilization with organomineral fertilizers combining first with soluble or reactive phosphate and to evaluate the residue effect for beans and soybeans to be grown afterwards. Three fertilizer applications showed higher yields compared with control. They reported that organomineral fertilizers with the addition of poultry residue increased yields in cereals, achieving average yields equal to or higher than the values obtained with special fertilizers [20].

Audu and Samuel in a research study conducted was to determine effect on "Growth Performance and Some Chemical Properties of the Soil". Urea, rock phosphate, wood ash, neem seed, blood flour, cottonseed meal, cow dung and poultry droppings were prepared as organomineral fertilizer at the grade N:P:K-9:3:3. The application of 250 kilograms of fertilizer per hectare gave the highest increase in pH, the total nitrogen, phosphorus present, the number of leaves and siblings per plant, the lowest values in all parameters were recorded out of control. From the findings of this research, they deduced that it improves the nutrient condition of the soil and the growth and yield of rice, therefore, organic waste fortified with mineral fertilizers has great potential in improving soil fertility [21].

Olowoake in a research study conducted was to determine Organic, mineral and organomineral fertilizers grain amaranth (*Amaranthus cruentus* L) plant growth, yield and soil properties effect investigated the growth, yield and soil properties as well as residue effects of organic, mineral and organomineral fertilizers in grains in Nigeria. As a result of the research, the evaluated parameters were significantly affected by the ferti-

lizer applied ( $p < 0.05$ ). Organic fertilizers fortified with mineral fertilizer were reported to perform well in amaranth production was improved soil fertility and could also be used effectively. The dry shoot weight of *Amaranthus cruentus* was significantly higher ( $p < 0.05$ ) than NPK application after the first crop. They also reported that organic fertilizers fortified with mineral fertilizers can be used effectively compared to NPK and increase soil fertility [22].

Deeks et al in a research study conducted was to determined Sewage sludge was rich in phosphorus, but low in nitrogen and potassium. They reported that in order to produce an organomineral fertilizer with balanced crop nutrient requirements, it is necessary to supplement the sewage sludge with mineral fertilizers such as urea and potassium muriate as sources of nitrogen and potassium, respectively. As a result, it showed that, except for one product, there was no significant difference in crop yield over the three trial years. This finding suggests that the new organofertilizer is as efficient as mineral fertilizers, and that the application were not increase the levels of heavy metals in the soil. Organomineral fertilizer has been reported to be a promising alternative product for sustainable agriculture [23].

Ayeni et al in a research study conducted "Organic, Organomineral and Mineral Fertilization of Corn (*Zea Mays L.*) Comparison of Effects on Growth, Nutrient Intake, Soil Characteristics and Yield" conducted four repetitions of 5m×5m parcel size according to a two-year full chance coincidence blocks trial pattern in Ondo in southwestern Nigeria. As a result of the study; compared with control, MV, OMF and NPK fertilizers, plant N, P, K, Ca, Cu, Fe, Zn and Mn increased significantly ( $P < 0.05$ ), corn also increased plant height, number of leaves, leaf area, root dryness, matter and grain yield compared with control ( $P < 0.05$ ). They reported that even at low application doses, organic and organomineral fertilizers can be used to increase plant nutrients and corn production [24].

Lordache in a research study conducted was to determined the Abundance of worms under organomineral fertilization in a chernozem in the west of romania, the effects of two organomineral fertilizers coated with humic acid and potassium, defined as HF1 and HF2, on the population of earthworms were investigated, and in the two-year study conducted in Chernosia soils in Romania, corn plants were grown in the first year and sunflower plants in the second year. As a result of the research, it was observed that the density of earthworms in the soil where HF1 from organomineral fertilizer was applied was higher than HF2 and control [25].

Akanni in his research study conducted was to determined the effect of organic and organomineral fertilizers on Soil Properties, growth, yield and nutrient content in corn, pepper and amaranthus plant is low in organic matter, N and P in the rainforest region of Nigeria, is low in terms of organic matter, N and P. As a result of the study, it was reported that 300 kg ha<sup>-1</sup> OMF, organic and NPK fertilizer increased soil and plant N, P, k, Ca, Mg and yield in corn, pepper and amaranthus, while the highest corn cob and grain weight were reported to give the highest number of pepper fruits by 3.0 t ha<sup>-1</sup> OMF and NPK. OMF has been reported to give the highest yield param-

eters, soil and plant nutrient content, highest soil moisture values and appropriate soil physical properties [26].

Ojetayo et al in a research study conducted was to determined effect of fertilization varieties on the nutritional quality of two cabbage types before and after storage, in their conducted research in Nigeria to determine the effects of different organomineral fertilizer varieties on the nutrient content of two cabbage varieties before and after storage. Before and after storage, the number of rotten leaves, the degree of rot and the nutrient composition of the cabbage were significantly affected ( $p = 0.05$ ) and the organomineral fertilizer affected by the applied fertilizers and varieties provided optimum nutrient compositions before and after storage. NPK applications provided more vitamin C and organomineral fertilizers, the highest content of phosphorus, potassium and crude protein [27].

Korkmaz et al in a research study conducted was to determined the effects of organomineral fertilizers of different chemical and organic origin on the yield of silage corn and the efficiency of phosphorus Intake, At the end of the research, it was determined that the phosphorus intake efficiency, nutrient content and yield of silage corn changed depending on the amount of fertilizer and phosphorus application applied. Phosphorus uptake efficiency differed according to the phosphorus dose applied and the source of administration [28].

Pekcan and Çokuysal in a research study conducted was to determined of the heavy metal content of some liquid organic and organomineral fertilizers used in the fertigation system, emphasized that the climatic changes caused by global warming in recent years have significantly affected the rainfall regime of the countries and as a result, the water used in cities, industry and agriculture should be used in the most economical way [29].

Özer in a research study conducted was to determined the effects of different organic and inorganic fertilizers on agricultural properties, essential oil ratio and composition" is to determine the effects of different inorganic and organic fertilizers on yield parameters and essential oil ratio and components in reyhan (*Ocimum basilicum L.*) plant. As a result, it has been reported that amonium sulfate and chicken manures and organomineral fertilizers stand out in terms of essential oil in terms of yield values. In the study, it was emphasized that organomineral barn, chicken and organomineral chicken manures can also be alternatives to chemical fertilizer in terms of sustainability in reyhan cultivation [30].

Öner ve Öner in a research study conducted was to determined the effect of addition of different chemical fertilizers to solid farm fertilizer on the water solubility of some nutrient elements under laboratory conditions. After mixing chemical fertilizer with unburned fresh solid cattle manure, it has been reported that the amount of water-soluble phosphorus, magnesium, calcium, sodium, zinc, iron, copper and manganese in the fertilizer and the fertilizer dose, time and fertilizer dose interaction are significant at the level of  $p < 0.01$  and the solubility of other elements increases with increasing fermentation time and phosphorus solubility decreases [31].

Solmaz et al in a research study conducted was to determine effect of microbial encapsulation of mineral and organic fertilizers on the effectiveness of fertilizer use in wheat cultivation.

The best results in the study were obtained from microbial coated and uncoated applications of 20 kg da<sup>-1</sup> 20:20:0+30 kg da<sup>-1</sup> 25:0:0 fertilizers [32].

Bahadırılı and Dogan in a research study conducted was to determine "The Effects of Mineral and Organic Fertilizers on some Soil Microbial Activity and Yield in Potato (*Solanum tuberosum* L.) Plant Grown in Hatay-Reyhanlı". As a result of the study; The highest yield was obtained by the application of compound organic fertilizer in the Madeleine variety, the application of AG2 in the Madeleine variety with the highest CO<sub>2</sub> activity, the application of AG2 in the Melody variety with the highest dehydrogenase enzyme activity and the application of AG2 in the Melody variety with the highest microbial biome carbon values. CO<sub>2</sub> and dehydrogenase enzyme activity were not statistically affected in the variety difference, while tuber yield and microbial biome carbon values were affected. Organic and organomineral applications were found to be statistically significant (p<0.05) in the parameters of the study [33].

Demir ve Tangolar in a research study conducted was to determine "Effects of Organic and Organomineral Fertilizer Applications on Yield, Quality and Plant Nutrition in Black Magic Grape Variety". As a result of the study, the effect of fertilizer applications on yield and cluster weight with plant nutrition was not found to be important and the effect on wort properties was found to be important. The maximum water soluble dry matter value was obtained from organomineral and organic+organomineral fertilizer application and the highest yield and inflorescence weight were obtained from leaf applications. It has been formed that the effects of organomineral and liquid organic fertilizers on grape yield and quality can be seen in the first year by applying them from the leaf and that the effect will continue to increase in the following years. At the same time, it is emphasized that the way of applying fertilizer is also important [34].

Tuga et al in a research study conducted was to determine "Effect on Yield and Plant Nutrient Content in Crispa"; It was aimed to determine the effects of three different organic materials (gidya, leonardite, vermicompost) and three different doses of fertilizers (3%, 6%, 9%) and control group (0%) applications consisting of garden soil on plant nutrient content were used. As a result of the study; The effects of the applied organic substances on the yield components were found to be significant and while vermicompost application increased the yield by approximately two times, there was no statistical difference between the doses. It has been reported that the effect of vermicompost on earliness in curly leaf salad is statistically significant and gives good results especially in the intake of K<sup>+</sup>, Cu<sup>++</sup> and Zn<sup>++</sup> elements. It has been determined that gidya applications do not give positive results in terms of plant nutrient content [35].

Tuga et al in a research study conducted was to determine "The Effect of Some Organic Materials on Ion Intake of Watermelon (*Citrillus lanatus* Thunb.)" In their research titled Crimson Sweet (*Citrillus lanatus* Thunb.) watermelon variety, three different organic materials (vermicompost, leonardite, gidya) and three different doses (3%, 6%, 9%) and garden soil were observed to affect ion uptake in watermelon. In the sam-

ples taken from the leaves, differences were observed between both the applications and the doses of the applications in terms of nutrient content [36].

Korkmaz et al in a research study conducted was to comparison of the effects of organomineral fertilizer and K-humate on the yield and phosphorus utilization efficiency of grain corn with chemical fertilizer; fertilizer applications were found to be insignificant in grain yield and the agronomic and reuptake efficacy of phosphorus was statistically significant (P<0.05). The physiological, agronomic, and reuptake efficacy of phosphorus was found to be higher in chemical fertilization than in organomineral fertilizers. It has been reported that K-humate applications with chemical fertilizer are more effective because K-humate application converts soil phosphorus and applied phosphorus into more beneficial to plants [37].

Toprak in a research study conducted was to determine "The Effect of Iron-Rich organomineral fertilizers on the Nutrition of Apples" is to examine the nutritional effect of iron-rich organomineral fertilizer doses on apples in calcareous soil in Eskişehir ecological conditions for two years. As a result of the study, iron-rich organomineral fertilizers applied in increased doses increased the content of N, P, K and Fe in the leaf, decreased the content of Ca, Mn, Zn and Cu, did not change the Mg content. The dose to be administered to apple trees has been reported to be FeOMG2 [38].

Özdemir investigated the effects of different organomineral and organic fertilizers on shoot development in Öküzgözü and Bogazkere grape varieties as a result of the study; The shoot length was obtained from the application of Bactolife High Organo 5-5-0 fertilizer in Öküzgözü grape variety and Bactolife High Organo 5-5-5 fertilizer application in Bogazkere grape variety. Fertilizers caused significant differences in the length of shoots of varieties [39].

Namlı et al in a research study conducted was to determine the effects of organic and organomineral fertilizers developed from the organic materials of the Afşin-Elbistan basin lignite plant on wheat yield and yield components and some soil characteristics. As a result, the organic material increased the plant height and at the same time, the application of organic materials given to the soil alone and together with chemical fertilizers increased the wheat yield significantly compared to the chemical application of 20 kg da<sup>-1</sup> DAP in the region. All applications increased the pH, organic matter and changeable K value of the soil according to the control (p<0.05), and it was determined that the organic materials in significant quantities in the Afşin Elbistan Lignite operation site could be evaluated as organic organomineral fertilizer, soil regulator, humic acid and K-humate by conducting content analyzes [40].

Ateş ve Tekeli in a research study conducted was to the effect of grass yield and quality on grass. In the research where they established 3 repetitions according to the two-year coincidence blocks trial pattern in Edirne-Keşan, they used Töre fodder pea variety and 3 different base fertilizers (18-46-0, 20-20-0 and 8-21-0 organomineral fertilizers) used in the region, morphological observations (plant height, number of branches and leaf/stem ratio) and green grass yield (measured during the full flowering period of fodder peas) and then dry grass yield, raw protein, ADF and NDF ratios have been determined. The

highest plant height, number of branches, leaf/stem ratio, green grass yield, dry grass yield, NDF and crude protein ratio and lowest ADF ratio were obtained from the application of organomineral base fertilizer (8-21-0) [41].

Namlı et al in a research study conducted was to determined organomineral fertilizers, humic acid, organic soil conditioners provided from organic materials in Afşin Elbistan Lignite plant and their effects on wheat plant and some soil characteristics. In all of the fertilizer applications used in the trial, the amount of organic matter increased significantly compared to the mineral fertilizer applications alone and control, and the highest N was determined in the 10.10.10 organomineral fertilizer application, and the highest retrievable P scope was determined in the combined application of organic soil regulator and DAP fertilizer. Plant height has not increased compared to control in all applications. The highest wet weight was 10.10.10 organomineral fertilizer and the highest dry weight was seen in 15.15.15 chemical fertilizer application alone, and the highest N and P contents were seen in soils with 1lt humic acid applied to the plant [42].

Süzer and Çulhacı in a research study conducted was to determined the effects of winter bread wheat (*Triticum aestivum* L.) on grain yield and some yield elements, they tried two years in Selimiye Winter Bread wheat variety and four repetitions and seven different applications in the coincidence blocks trial pattern in Edirne. As a result of statistical analysis; the highest grain yield was obtained at an average probability level of 5% from Hexaferm 12N.12P.0K+12S from Hexaferm® 12N.12P.0K+12S to the bottom of the ground before sowing in autumn and 15 kg da<sup>-1</sup> in spring fraternization from the application of fertilizer da<sup>-1</sup> kg da<sup>-1</sup> in the pen laying period of urea+ plants [43].

Batanay in a research study conducted was to determined effect on yield and yield Properties in Plants", he aimed to determine the effects of the phosphorus element absorbed in the calcareous region soils in Yozgat-Sarıkaya with humic acid and the effects of the applied organomineral fertilizer on the yield and yield characteristics of the Balcı safflower (*Carthamus tinctorius* L.) variety, and according to the coincidence blocks trial pattern, three repetitions and three different plant nutrients (Organomineral Fertilizer, Humic acid and Humic Acid+Organomineral Fertilizer). In his study, was observed that the combined use of humic acid and organomineral fertilizers significantly increased the yield and quality values of the Balcı variety, and that the use of humic acid in calcareous soil conditions had positive contributions [44].

Eleroglu and Korkmaz in a research study conducted was to determined effects of the use of chicken manure and organomineral fertilizers on yield and quality in seed tubers of different potato varieties. In fertilizer applications, there was no statistically significant difference on the average output time, exit rate, plant height, number of main stems, total tuber yield, crack tuber yield, dry matter content, starch content and specific gravity of the varieties, and the difference observed between the varieties was insignificant. The difference between the average pit tuber yield, total tuber yield, crack tuber yield, dry matter content, starch content and specific gravity averages of the varieties was found to be important. Fertilizer

applications have had a significant impact on the yield of varieties per quarry. FertilizerxVariety interaction was found important in terms of average tuber yield and specific gravity averages per quarry. As a result, from an economic point of view, it can be used instead of organomineral fertilizer applications of compost or fermented chicken manure in potato production [45].

Süzer and Çulhacı in a research study conducted was to determined effects of different organomineral and Inorganic compound fertilizers on Seed Yield and Some Yield Components of Sunflower (*Helianthus annuus* L.). As a results fertilizer applications significantly increased seed yield compared to control and although the effects of the applications on yield were similar, the highest yield was obtained from Hexaferm 6.10.10 fertilizer [46].

Günay in a research study conducted was to determined the effects of organomineral fertilizer applications on some quality parameters and yield of sunflower were examined. In the study, 15 kg da<sup>-1</sup> and 25 kg da<sup>-1</sup> of 12-12 and 10-25-0 commercial organomineral fertilizers (BIOCOMP) containing 80% mineral, 20% organic matter were used and compared with 25 kg da<sup>-1</sup> dose application of 15-15-15 and 20-20-0 compound fertilizers, which are mostly preferred in sunflower agriculture. As a result, when fertilizer applications are compared, it is reported that the most effective application on yield characteristics is 12-12-12 (25 kg da<sup>-1</sup>) organomineral fertilizer and that the organomineral fertilizers used increase the content of nitrogen, phosphorus and potassium, which are essential plant nutrients in sunflower, compared to mineral fertilizers [47].

Özyazıcı et al in a research study conducted was to determined reaction changes and spatial distributions of yield and quality of kiwi, corn, hazelnut, cabbage, tangerines tea and other agricultural products grown agricultural soils. As a results sub-plant agriculture in these areas where soil acidity increases and a certain program is made especially in the time of rejuvenation of tea in tea soils that have gained extreme acidity. Framework, they reported that it would be appropriate to use soil conditioners or organomineral fertilizers with a high lime content [48].

Özkan in a research study conducted was to determined the effects of some organomineral and nitrogen fertilizers on the quality and development of perennial grass varieties, and used two different pelletized organomineral fertilizers (P-SPEED and Plentkeep STANDARD JPG 25) containing 0, 2.5, 5 g m<sup>-2</sup> nitrogen fertilizer (AN, 33%) doses and 4 g m<sup>-2</sup> as 4 g m<sup>-2</sup>. As a result of the study; It is reported that fertilizer applications are effective in different degrees and that the rate of dry matter is higher in the parcels where organomineral fertilizer is applied [49].

Çalışkan and Ayan in a research study conducted was to determined the effect of organomineral fertilizer with NPK in different doses on yield and some yield components in nettle (*Urtica dioica* L.). Fertilizer applications were in the form of 0, 10, 15 and 20 kg da<sup>-1</sup>. In the research carried out for two years, agricultural characteristics such as plant height, stem thickness, number of branches, wet biomass yield and dry stem yield were examined, and the highest values were obtained

from 20 kg da<sup>-1</sup> application [50].

Pekcan et al in a research study conducted was to determined effects of organomineral, mineral and Farmyard Manures on The Yield and Quality of Olive Trees (*Olea Europaea L.*)" In their research, compared the effects of leonardite pelleted organomineral fertilizer mineral fertilizer and mineral fertilizer pelleted with fulvic acid on olive yield, quality and mineral nutrition with chemical fertilizers with N, P and K and farm fertilizer. As ca results, it was stated that the highest yield in annual yield and average yield was obtained from the Organomineral fertilizer application, followed by the application of Mineral fertilizer+Barn fertilizer. The effect of the applications on the quality parameters of the olive was found to be insignificant [51].

Akıncı et al in a research study conducted was to determined effects of registered organomineral fertilizers on the yield and yield elements of bread wheat studies, examined the effects of some registered organomineral fertilizers on the yield and yield elements of bread wheat and reported that organomineral fertilizers had statistically significant effects on yield, thousand grain weight, plant height [52].

### 3 RESULT

When we look at the results of the studies conducted in the world and in Turkiye, it is seen that organomineral fertilizers may have effects that may vary in yield parameters according to the plant, soil characteristics and fertilizer type grown. In some studies, it has been emphasized that it is more effective than mineral fertilizers in terms of yield parameters, but in most studies it is superior in terms of its effect on soil properties. In most of the studies, it has been reported that the yield values of organomineral and mineral fertilizer applications are close to each other and organomineral fertilizer will be a very good alternative to mineral fertilizer.

In recent years, especially considering that our population has increased day by day and our agricultural areas have decreased, organomineral fertilizers have a great importance in soil conservation. In the studies, it is reported that organomineral fertilizers have positive effects on the physical, chemical and microbiological properties of the soils and make an important contribution to the soil organic matter and microorganisms.

### 4 CONCLUSIONS

Overall, research has shown that organomineral fertilizers can improve plant growth parameters such as yield and nutrient uptake to a greater degree than when manure or fertilizers are used alone in the organomineral fertilizer studies conducted in the world and in Turkiye, fertilizer material commercial prod-

ucts were generally selected, and in some studies, commercial and organic fertilizer combinations were used together. In the majority of the researches carried out, findings have been obtained regarding the positive effects of organomineral fertilizers on soil characteristics, yield and quality. The number of studies conducted in Turkiye is less than the number of studies conducted in the world. Increasing research studies on organomineral fertilizers, which are extremely important in terms of sustainable soil fertility, is of great importance for our country's agriculture.

Unlike conventional fertilisers, every application of an organomineral fertiliser is also adding organic matter to the soil. This helps to regenerate soils, building a bigger 'nutrient store' in the soil which increases 'natural fertility' for season-long, soil nutrient supply to build long term yield resilience. There is also an improvement in soil structure for better crop establishment and an increase in nitrogen use efficiency meaning less nitrogen needs to be applied.

Organomineral fertilizers; It improves plant growth and soil structure by retaining more nutrients and water. At the same time, the organic material holds the nutrients and heavy metals in the soil to be transported to the bottom water by drainage with its large surface area. It is recommended that OMF is incorporated into the seedbed for spring sown crops and The Safe Sludge Matrix guidelines followed.

Organomineral fertilizers; It will also make an important contribution to protecting human health and creating a food web in the soil. The number of different quantities or methods of different organically sourced wastes should be increased and the results obtained by greenhouse and field work should be calibrated.

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